Biological Scope

We have analyzed the impacts of different CalFed scenarios using the three species that represent types of fish likely to be affected. Some species, such as those that live their entire lives upstream or downstream of the delta are unlikely to be affected by changes in point of diversion in the delta. Other species, such as tule perch or largemouth bass, have life history characteristics that make them much less sensitive to hydrodynamic conditions or entrainment were also excluded. The three species we examined included Sacramento and San Joaquin salmon to represent anadromous species with the shortest exposures to delta conditions. Striped bass, an anadromous species, and delta smelt, a resident species, represent species with greater exposure to delta conditions. Other species that may be affected by changes in delta conditions, but whose responses may differ from the species analyzed here, include: green sturgeon, white sturgeon, longfin smelt, Sacramento splittail, and American shad. CalFed may need to develop a future analysis to address these species.

Geographic Scope

The geographic scope of the CalFed "solution area" encompasses all of the Central Valley, San Pablo and San Francisco bays, and the near-shore Pacific ocean. Our evaluation of diversion effects on fish populations was confined to the legally defined Delta, Suisun Bay and Suisun Marsh. Consequently, we did not incorporate into our evaluation the potential beneficial and adverse effects of actions outside that area. Fluctuations in ocean and bay conditions, salmon and striped bass harvest management, CalFed's Ecosystem Restoration and Water Quality programs that occur outside the delta, and actions associated with the Central Valley Project Improvement Act (CVPIA) are all likely to affect fish populations.

Restoration and recovery of these three species will also depend on CalFed actions outside of the "problem identification area" that we have addressed. CalFed's actions must also address many issues of greater uncertainty than those we have addressed. Therefore, we are unable to assess the degree to which the effects of these delta-based scenarios contribute to overall restoration and recovery. A far more complex and time-consuming analysis would be necessary to integrate the Delta effects we identify, with the broader range of natural fluctuations and human activities that will determine recovery.

We have identified the principle mechanisms by which storage and conveyance will affect these species, when these species are in the Delta. We have assigned relative ranks to summarize our assessments of the balance of impacts and benefits for each scenario.

Process

Evaluations were based on the team's best professional judgement of the degree to which each relevant parameter affects each of the key species. The judgements considered empirical relationships between parameters and survival, where such relationships were available. Evaluations were based on operations modeling studies and qualitative assessments of the degree

to which water operations, water management facilities, and biological factors affect the populations of each species. More rigorous quantitaive analysis was not possible within the time constraints imposed onthis process.

The evaluations recognized the many sources of uncertainty that derive from the limitations of our scientific knowledge about the species and Bay-Delta ecosystem. From an analytical perspective, monthly averaged hydrology was the primary hydrologic parameter used in the analysis. For example, the use of particle tracking model output, which is based on short time-steps, would help reduce this uncertainty.

Sources of uncertainty on biological processes takes a variety of forms and makes any predictions of actual results at the population level extremely problematic. For the species we considered, for example, the benefits of shallow water habitat to Delta smelt are not yet well understood. With regard to striped bass, the continuation of historic relationships into the future is unclear due to the many changes in the system. For salmon, the sources of mortality in the Delta are poorly understood. The various sources of uncertainty were acknowledged, identified, and considered to the extent possible in the evaluation

Procedures and Inputs

Evaluations are based on a single operations study for each scenario. There has been no attempt to minimize impacts or maximize benefits. The next phase of the teams efforts will be to optimize the alternatives. The specific CALFED operations studies used for each scenario were: Existing Conditions-558, NoAction-516, Alternative 1 without storage-518, Alternative 1 with storage-609, Alternative 2 without storage-528, Alternative 2 with storage-532a, Alternative 3 without storage-595, and Alternative 3 with storage-567. These runs included meeting the flow requirements for the Vernalis Adaptive Management Plan (VAMP), meeting the 1995 WQCP, and the biological opinions for delta smelt and winter-run chinook salmon. Analyses were based on monthly flows at selected locations in the Delta averaged over all years and averaged over selected dry and critical years. No attempt was made to explore the full range of annual variability

Using the model runs above, each alternative was analyzed with no storage and with maximum storage. This range of storage represents the extremes of existing storage to an additional 6.2 MAF of new storage. Storage between these two extremes would have marked results on the outcome of these evaluations. There was no attempt to minimize impacts or maximize benefits by optimizing storage.

For each alternative, the model runs produced average monthly flows at locations throughout the Delta. Wet and dry year flow summaries were used in the evaluation of impacts of an alternative. In some cases , using average monthly flows and monthly summaries could minimize the actual impacts or benefits of an alternative. The team attempted to account for the model limitations in their evaluations.

Incorporation of Common Programs

The evaluation of the effects of the Common Programs posed particular challenges for this evaluation. For example, at the current programmatic level of development, the distribution of restored/rehabilitated wetland and riparian habitat has not been defined. Different distributions of habitat would benefit different species. However, even if the distribution were clearly defined, our current level of scientific knowledge limits the evaluation of the benefits that would accrue to each species.

There was a broad consensus among the team that the common programs will provide benefits to each of the evaluated species. The quantification of these benefits is, however, not possible at this time. Increasing the amount of habitat will almost certainly increase the potential for survival of each of the evaluated species, but the magnitude of the increase is uncertain. Some negative impacts of the water quality program on striped bass are considered.

III. Unaddressed Issues

Water Quality

Changes in point of diversion would effect a variety of water quality parameters in the Delta. San Joaquin River water carries a significant load of agricultural chemicals, selenium, and other contaminants and nutrients. Sacramento River water generally carries lower loads and carries different metals such as copper, mercury, cadmium and zinc. Delta water directly receives a variety of agricultural chemicals (including herbicides), salts and organic carbon. Contaminant loads and concentrations vary seasonally, vary with hydrology, and can be expected to vary with different points of diversion and changes in operating criteria. The availability and effects of these chemicals on fish populations, and the food web that supports them, are unknown but potentially significant. Impacts may occur through direct toxicity, but are more likely through chronic effects or trophic disruptions. Synergisms of chronic effects with other factors such as disease or reduced growth that prolongs exposure to predators may also result in effects on fish populations. Changes in the point of diversion could also affect the transport of ocean derived salts in the Delta. The Diversion Effects on Fisheries Team has not attempted to incorporate any of these contaminant effects into the evaluations of fishery impacts. A team of appropriate experts should be formed to evaluate these factors and help the Diversion Effects on Fisheries Team to revise the present report.

Exotics

The Bay/Delta is dominated by non-native species. Some introduced species have substantially altered the functioning of ecosystems they have invaded and we have limited understanding of the new ecological relationships among species. New species will likely continue to arrive and disrupt the biological communities of the estuary in the future. All data and analyses, therefore, that rely on historical relationships may not predict the future but they are the only available basis for analysis. The almost certain arrival of new species in the future may alter the ability of the estuary to support these three species but the group feels it is unlikely that effects of new species introductions will change the results of this analysis.